some trial radiant-points for any remarkable shooting-stars or large meteors of the two past years' expected maximum *Bielid* periods which may have been recorded.

Observatory House, Slough, A. S. HERSCHEL.
December 16th, 1899.

Is New Zealand a Zoological Region?

WILL you allow me to make one remark on the letter of Mr. H. Farquhar (p. 246), advocating an affirmative answer to the above question. It is this: Throughout the whole argument there is an assumption which vitiates it, namely, that the amount of resemblance of the New Zealand fauna to that of *Australia* is what alone determines its resemblance to that of the *Australian Region*.

Apparently, Mr. Farquhar does not believe that New Caledonia and the New Hebrides belong to the Australian Region, otherwise he would not adduce the fact of the land-shells of New Zealand being related to those of the above-named islands as an argument in his favour; and if these are omitted, then must New Guinea be also omitted. And if Australia by itself is to become a "Zoological Region," New Guinea and its surrounding islands must be also a "Region," the Central Pacific Islands another, and the Sandwich Islands yet another! This indicates the difficulties that arise if the Australian Region, as originally defined by Dr. Sclater and myself—and which I still hold to be far more natural than any subdivision can make it—be rejected.

ALFRED R. WALLACE.

Molecular Structure of Organised Bodies.

PROF. VINES, in his "Physiology of Plants," says that the molecular structure of cells can only be inferred from their properties, and that a correct conception of this structure is essential for a proper comprehension of cell growth. In the same work the author also states that Naegeli argues: "Since the optical properties of these organised structures are apparently not dependent, like those of a crystal or a piece of glass, upon the relative position of their constituent particles, they must be inherent in the particles themselves. Each micellæ, then, possess the optical poperties of anisotropic crystals. Naegeli concluded, therefore, that the micellæ are crystals."

Naegeli's micellæ theory rests almost entirely on the failure of any effort to temporarily destroy the anisotropism of organised structure. Obviously, if it were possible to so act on or swell a vegetable fibre that its anisotropism were destroyed, and that this anisotropism returned after the treatment were discontinued, Naegeli's theory, as far as it relates to the optical properties of micellæ, would fall to the ground.

It is well known that organised structures cease to be doubly refractive at the moment when their organised structure is destroyed. This is usually explained by saying the micellæ are at the same time disintegrated.

As far as I am aware, it has never been shown that this property of double refraction, common to organised structures, can be destroyed by suitable swelling, and restored again when the body returns to its original condition. I have been able to do this, in the case of cotton fibre, and it seems to me to give the *coup de grace* to Naegeli's theory.

I take it that if in one instance the anisotropism of organised structure can be temporarily destroyed, it is a correct inference, that to do so in every case only requires a suitable medium; which will reduce the strains to a necessary degree without the destruction of the physical form of the organised structure.

In the course of some investigations on the destruction of nitro-cellulose fibres, by means of solvents, I observed that in one particular case the double refraction disappeared long before the physical structure, and that on getting rid of, or diluting the solvent, the anisotropism returned. It is because I think this observation will be of interest to biologists I am troubling you at length.

It is well known that on converting fibrous cellulose into nitro-cellulose, the fibres retain their optical properties as regards polarised light. Nitro-cellulose, however, has a very wide range of solvents, and the examination of organised fibres when treated with solvent, becomes very extended.

Most nitro-cellulose solvents, such as acetone, nitro-benzene, the ethers, &c., do not lessen the anisotropic properties. The fibres may be swollen to twice their diameter, but still polarise light, until their physical structure is quite gone. This is not so, however, if nitro-cellulose fibres are acted upon with a mixture of acetone, benzene and ethyl alcohol. With this solvent the nitro-cellulose becomes gelatinised, and the anisotropism disappears, yet on examination the fibres are seen to be present in great abundance. These isotropic fibres can be given their double refractive properties again, by diluting the solvent with excess of alcohol or benzene.

The accompanying photographs show this action very well.

Nitro-cellulose was prepared from cotton-wool, with large excess of acids, so that there should be no unnitrated fibres present. The resulting nitro-cellulose was practically all of the

FIG. I.

insoluble variety, and contained 13·3 per cent. nitrogen. It wa completely soluble in excess of acetone, and contained no cotton fibres.

Some of this nitro-cellulose was treated with ten times its weight of a solvent consisting of:

6 parts benzene
3 ,, alcohol
2 ,, acetone

and allowed to stand in a stoppered bottle twenty-four hours, a jelly resulted.

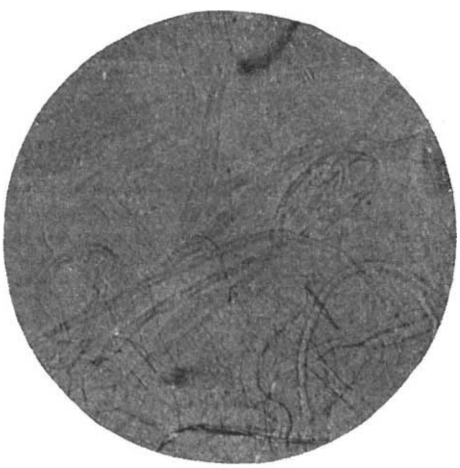

FIG. II.

Figs. I., II. and III. are from a little of this jelly, mounted with two crossed cotton fibres to fix the point of view, and give an object to focus and develop. The three photographs are taken from the same slide and the same point of view.

Fig. I. is a view under crossed nicols of the jelly, and taken immediately after mounting. It will be noticed that the object shifted slightly during exposure.

Fig. II. is the same view, taken immediately after I., but with the polariser opened a little.

Fig. III. was taken after the slide had been treated with Canada balsam and benzene, and allowed to stand five days fixed in the microscope. The benzene and Canada balsam gradually diluted the solvent and brought back the anisotropism of the nitro-cellulose fibres.

The magnification in all photos was × 50 diameter, and the exposure in I. and III. was in each case twice that of II.

In Fig. I. it will be observed that a little light is active besides the crossed cotton fibres. This is more noticeable in the negative. As a matter of fact, with this strength of acetone the anisotropism is just evanescent in a percentage of the fibres.

A comparison of Figs. II. and III. shows that nearly all the fibres seen in II. are anisotropic in III. The fibres obvious in

FIG. III.

II. and not evident in III. lie in the plane of polarisation. The fibres obvious in II. and III. are isotropic in I.

I leave the correct interpretation of these experiments to competent biologists. To me it seems probable that the anisotropism of fibrous cellulose is due to a strain put on the fibre by the tension of the most outward layer of the cell-wall, and that a medium such as here described lessens this tension, whereas ordinary inhibition does not. Some such a theory as the above seems necessary to account for the different action of solvents which swell organised structures. This view is a modification of Strasburger's theory, as I understand it, and would be independent of whether cell growth takes place by lamellæ or particles.

F. W. JONES.

Barwick, Herts.

School Science and Knowledge-Making Power.

THE lecture of Prof. J. G. Macgregor, as reported in NATURE, of December 14, is of very great interest to science teachers, more especially to those in secondary schools. It will afford great comfort to the still very large number of controllers of the curricula in such schools who do not really sympathise with, nor believe in, the good results obtained from scientific teaching. As one who has to deal with all ages of pupils in a large school, may I be allowed to make a few comments on Prof. Macgregor's lecture as it strikes a science teacher?

In class work it seems that the lower forms, when watching an experiment performed before them, are quicker to put one thing with another, and to be led to explain or suggest explanations of the results obtained. This is apparently in accordance with Prof. Macgregor's opinion, that younger pupils have a greater knowledge-making power.

Thus a class of boys, whose ages range from seven to nine years, is much more ready to ask and answer questions concerning the subject of the lesson than classes towards the middle of the school.

The reluctance shown, or the difficulty felt, by higher classes in answering or suggesting questions is considered by Prof. Macgregor to show a lessened power of knowledge-making possessed by them. But even if the science teaching is, throughout the forms, of a constant character in its aim of bringing out the inquiring spirit, in my own experience the same thing is noticed. Can there be another explanation? As boys grow older they are more careful not to make such mistakes in their verbal answers as would lead to the slightest ridicule on the part of their class fellows. Thus, by remaining silent, they give one the impression that they are not following the work with the ability shown by their juniors. Again, with increased experience, questions do not appear so simple in their nature; alternative explanations are suggested to the boy's mind, and the choice is difficult to make. It is possible that the few suggestive solutions offered by a higher form show more power than the many more obvious ones given by the lower form.

Prof. Macgregor says that at present Latin is the only subject which really brings out this knowledge-making power. Surely this is comparing the results obtained from the best classical teaching in small selected forms where each boy is really known to have done his work to the very best of his ability, with the results from science teaching of a very old-fashioned kind, in which the lesson, given to a large class, is of the nature of a lecture. Such a comparison may be made to the disadvantage of any educational subject. It is still the custom in some classes to learn Euclid's propositions by heart! Yet no one would think of displacing the subject on this account.

Referring to the difficulties of increasing the knowledge-making powers of boys, certain enemies are mentioned. There is the use of synoptic or cram-books, which has been found to be necessary to push pupils through examinations in which "knowledge is power" is held as the maxim. Such books, after all, only take the place of written notes of lectures given to the highest forms, and have the advantage of saving the pupil's time. Further, text-books do not all consist of this kind of publication; in fact, some of them are as interesting to an intelligent boy as one of the ordinary run of story-books. Properly used, text-books are of great value surely in this way: the whole attention of the scholar is directed to the demonstration, and after the lesson the book is used to refresh the memory, which it does, not simply by repeating the results, but also the deductions from the results and the necessary steps of reasoning involved.

Prof. Macgregor objects to text-books which contain details of practical work to such an extent that the pupil is told what to do, what to expect, and the reasons why. If the teaching is carried out under such a system as that referred to as the Heuristic, then in the practical text-book it is not necessary to include all these details, but some appear to me to be absolutely necessary. Teachers know well enough the difficulty of getting printed instructions accurately carried out; and certainly letting even a small class of moderately steady boys loose into a laboratory would give the controller of the laboratory an anxious time. If, then, instructions are needed, why not print them? They must otherwise be written on the blackboard, or be of a verbal nature—the latter involving many repetitions.

The best chance that practical science (of course, commenced as early as possible) has of producing knowledge-making power, appears to be in the opportunity it affords of solving questions in a manner closely following an experiment previously carried out. In this connection modern science teaching combines the advantages of the study of propositions in geometry and riders thereon, with employment, simultaneously, of brains and hands. Now an experiment previously carried out implies instructions given.

The other enemy referred to by Prof. Macgregor is the examination syllabus. It is certainly difficult under the best of circumstances for a teacher to go completely through, say, the Cambridge local examination syllabus in science on the Heuristic system, in the time usually allowed by school time-tables. With such a task in front of him the teacher is bound at times to descend, so to speak, to dogmatic teaching. The modern syllabus, both in this examination and in that for the London matriculation, covers so wide a ground that there is danger of the work becoming of the same character as it is said to have been under the older syllabuses. It would appear, even now, to be absolutely necessary to use "synoptic books" when such lengthy syllabuses are prescribed and written examinations held.

But it is hard to see how even a practical examination can test the knowledge-making power of boys when a lapse of